Amendments to the Drawings

Figures 3 - 12 are added by this amendment as required in the Office action. The amendments are supported by the claims as filed (as set forth in the Office action) and by paragraphs 28 and 40 of the specification. Replacement/new drawings sheets 1 - 7 are enclosed.

Remarks

Claims 1 - 26 will be pending after entry of this amendment. Claims 1, 3-4, 6-10, 17-18, and 23-26 are amended herein. Claims 27 and 28 are cancelled herein without prejudice as being directed to a non-elected invention. Applicants reserve the right to pursue patent protection for the subject matter of claims 27 and 28 in one or more divisional applications. Applicants appreciate the indication in the Office action that claim 4 is directed to patentable subject matter.

Applicants are also filing a supplemental IDS to address the issues raised in the Office action.

Amendments to Drawings and Specification

New drawing Figs. 3-12 are added herein as required by the Office action. The drawings illustrate features recited in the claims as filed and therefore do not add new matter. Support for the amended drawings is also found in paragraphs 28 and 40 of the specification. The specification is amended to add descriptions of the added drawing figures and to include reference to the drawing figures in the corresponding part of the detailed description.

Applicants maintain that the added drawings are not necessary for understanding the subject matter of the various dependent claims referred to in the Office action and are not required under 37 CFR § 1.81(a). The skilled person is able to understand layering, coating and/or dispersion of one material within another without illustration. See MPEP § 601.01(f). However, applicants submit the new drawing figures under the provisions of 37 CFR §1.81(c) as set forth in MPEP §608.02 since the subject matter can be illustrated. The new drawings figures are only examples of the many possibilities and are not to be considered limiting in any sense.

Rejections based on 35 U.S.C. § 112

Claims 7, 8, and 10-26 are rejected as being indefinite under 35 U.S.C. § 112, second paragraph because the phrase "diamond-like" is alleged to be indefinite. However, the phrase "diamond-like carbon" (sometimes shortened to "DLC") is a term of art understood in the industry to refer to a class of materials containing a significant fraction of carbon atoms and possessing some properties resembling those of diamond but lacking the long range crystalline structure of diamond. Some diamond-like carbons may be considered amorphous while others may be considered as including crystallites, justifying the relatively broad name for this class of materials. "Diamond-like carbons" are commercially available from various sources including Morgan Advanced Ceramics, which offers a proprietary diamond-like carbon product known as Diamonex® (which is referred to in ¶ 39 of applicants' specification). Other commercial suppliers of diamond-like carbon products include Anatech LTD, Nanotec Corp., and Umicore Coating Services. Applicants also note that the online encyclopedia Wikipedia includes a short entry for "Diamond-like carbon", a copy of which is submitted herewith.

In view of the foregoing, applicants submit that the phrase "diamond-like carbon" in the claims is definite and respectfully request reconsideration and withdrawal of the § 112, second paragraph rejection.

The Claimed Invention is Patentable over the Prior Art

Claims 1-9 and 18

Claim 1 is directed to a fluid sensor comprising:

> "**a resonator portion adapted for resonating in a fluid under test**; and an electrical connection between the resonator portion and a source of an input signal, including at least one electrode that is at least partially covered by a dielectric material; wherein the resonator portion, the electrical connection or both includes a base material **and a performance-tuning material that is different from the base material, is relatively hydrophobic, and exhibits a porosity of less than about 5% of its volume.**"
> (Emphasis added.)

Claim 1 has been amended to clarify that the sensor is a fluid sensor and that resonator portion thereof is adapted to resonate in a fluid under test. Paragraphs 14, 16, and 22 and 23 of the specification support the amendment. The fluid sensor is patentable in that the prior art fails to show or suggest a fluid sensor comprising a base material and a performance-tuning material that is different from the base material, is relatively hydrophobic, and exhibits a porosity of less than about 5% of its volume.

U.S. Patent No. 5,918,354 (Ikegami) is directed to a tuning fork resonator suitable for timekeeping applications. Ikegami does not disclose a fluid sensor. The tuning fork is hermetically sealed inside an outer case 4, preferably so the tuning fork is maintained in a vacuum environment. (Col. 8, lines 12-17.) The skilled person recognizes that resonators are commonly vacuum sealed in this manner for use in timekeeping applications (e.g., in a quartz crystal watch) in order to minimize the influence of the surroundings on the behavior of the resonator. Although the tuning fork in Ikegami may technically be operating in a fluid (i.e., a very low pressure gas) due to inability to achieve a perfect vacuum, the tuning fork is not adapted to resonate in a fluid under test because the case prevents the tuning fork from having any substantial

interaction with a fluid to be tested. Thus, there is no way for a fluid under test to influence the behavior of the tuning fork such that information about the fluid under test can be obtained from the tuning fork. Accordingly, claim 1 is unanticipated by Ikegami because Ikegami fails to disclose a resonator portion adapted for resonating in a fluid under test.

Further, Ikegami teaches that the tuning fork may be coated with an electrically insulating resin film, which in one embodiment is a silicone resin film. The purpose of the resin film is to prevent debris that may be accidentally sealed in the case with the tuning fork or produced by deterioration of the resonator (e.g., flaking of material from the inside surface of the case) from short circuiting the electrodes used to stimulate the tuning fork. Another purpose of the resin film is to protect electrodes from oxidation by gases released into the vacuum sealed environment due to out gassing from the various parts of the resonator. Ikegami does not disclose the porosity, or any range of suitable porosity, of the resin film. Further, there is no basis for the conclusion in the Office action that a porosity of less than about 5% volume is inherent in the disclosure of a silicon resin film. See MPEP § 2112, subsection IV. Consequently, claim 1 is also unanticipated by Ikegami because Ikegami fails to disclose a performance-tuning material that is different from the base material, is relatively hydrophobic, and exhibits a porosity of less than about 5% of its volume.

Claims 2-3, 5-9, and 18 depend from claim 1 and are patentable for at least the same reasons. Claims 3-4, 6-9 and 18 are amended for editorial purposes to improve clarity and to eliminating a redundancy in claim 18.

Claims 10-17 and 19-23

Independent claim 10 is also directed to a fluid sensor having a resonator portion adapted for resonating in a fluid under test and a performance-tuning material that is different from the base material of the resonator that is relatively hydrophobic, and exhibits a porosity of less than about 5% of its volume. Claim 10 is unanticipated by Ikegami for substantially the same reasons as claim 1. Claims 11-17 and 19-23 depend from claim 10 and are patentable for at least the same reasons.

Claims 13-14 depend from claim 10 and further specify that the base material of the resonator portion is a particular material other than quartz. Claim 13 specifies that the material is lithium niobate. Claim 14 specifies that the base material is PZT. The Office action rejects claims 13 and 14 as being obvious in view of Ikegami, which discloses a tuning fork in which quartz is used as a base material. Ikegami does not disclose use of any material other than quartz as the base material of the tuning fork. Further there is no suggestion or motivation in the prior art, including Ikegami, to substitute lithium niobate or PZT for quartz as the base material of the tuning fork discussed in Ikegami. On the contrary, one skilled in the art would recognize that quartz is a superior material for timekeeping applications than lithium niobate or PZT. For example, lithium niobate is much more susceptible to temperature influences than quartz and would therefore be unlikely to match the performance of quartz in timekeeping applications absent extraordinary efforts to isolate the lithium niobate from temperature variations. Quartz is also known in the art to have a very high Q-factor, while PZT has a significantly lower Q-factor, which would lead one skilled in the art to avoid replacing the quartz base material in Ikegami with PZT.

Claims 19-21 depend from claim 10 and further specifies that the performance-tuning material includes a particular material. Claim 19 specifies that the performance-tuning material includes a fluoropolymer; claim 20 specifies that the performance-tuning material includes a ceramic; and claim 21 specifies that the performance-tuning material includes a metal nitride. Claims 19-21 are each rejected as being obvious over Ikegami in view of the general knowledge of the existence of the materials specified therein. However, there is no suggestion or motivation in the prior art of record to use any of those materials in the resin film of Ikegami. Accordingly, there is no prima facie case of obviousness. See MPEP §§ 2142; 2143.01. Therefore, claims 19-21 are submitted as patentable for the additional reason that the prior art of record fails to disclose or suggest including the specified materials in a performance-tuning material of a fluid sensor as set forth in claim 10.

Claims 17 and 23 are amended for editorial purposes to improve clarity and eliminate to eliminate a redundancy in claim 17.

Claims 24-26

Independent claim 24 is directed to a method of making a resonator comprising:

> "a) **forming a plurality of resonators on a common substrate**; the resonators including: a resonator portion adapted for resonating in a fluid; and an electrical connection including at least one electrode . . .**wherein the resonator portion includes: a doped or undoped base material . . . and a performance-tuning material** that is different from the base material . . .; and b) **separating the resonators from each other**. (Emphasis added.)

The amendment to claim 24 is for editorial purposes. Claim 24 is patentable over the prior art of record in that the prior art

fails to disclose or suggest a method a making a resonator comprising forming a plurality of resonators on a common substrate (e.g., a wafer) wherein the resonator includes a base material and a performance tuning material and then separating the resonators from each other.

Claim 24 is rejected as being an obvious variant of the manufacturing process disclosed in Ikegami. Ikegami discloses a manufacturing method comprising forming a plurality of tuning forks on a wafer, separating the tuning forks from one another, mounting a tuning fork on a plug, and then applying a resin film to the mounted tuning fork. (Col. 4 line 66 - Col. 5, line 35 and Col. 16, lines 16 - 64.) Ikegami does not disclose applying the resin film to the tuning forks before they are separated from one another. The rationale of the obviousness rejection is that it would be obvious to change the manufacturing sequence disclosed in Ikegami so that the resin film is applied before the tuning forks are separated from one another. Applicants disagree.

Ikegami teaches away from applying the film to the tuning forks until after they are mounted on the plug. Ikegami notes that applying a resin film before the tuning fork is mounted on the plug is undesirable because it requires a complicated masking step and also because it presents a risk that exposed metal may generate debris that could interfere with the operation of the tuning fork. (Col. 2, line 64 - Col. 3, line 6.) Ikegami does note that applying an insulating film to the tuning fork after it is mounted on the plug according to prior art methods resulted in film being applied to the sealing surfaces of the plug, thereby undesirably interfering with sealing the tuning fork inside the case. (Col. 3, lines 7-17.) However, Ikegami solves the later problem by teaching that a flexible resin film may be applied to the sealing surfaces of

the plug without impairing the ability to seal the tuning fork inside the case. (Col. 5, lines 21-26.) Ikegami also teaches that the frequency of the mounted tuning fork can be tuned by controlling the thickness of the film. (Col. 5, lines 30-35.) The skilled person understands that applying the resin film to the tuning forks before they are separated from one another would hamper, if not preclude, using the film deposition to individually tune the tuning forks to the desired frequency.

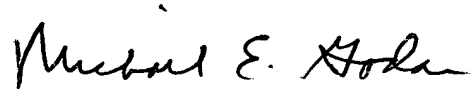
Thus, contrary to the rationale set forth in the Office action, a person having ordinary skill in the art would not be motivated to modify Ikegami's manufacturing sequence in the manner suggested in the Office action. Accordingly, claim 24 is patentable in that the prior art of record fails to disclose or suggest a method of making a resonator comprising forming a plurality resonators on a common substrate, wherein the resonators include a base material and a performance-tuning material, and then separating the resonators from one another. Amended claims 25 and 26 depend from claim 24 and are patentable for the same reasons.

Claim 26 further specifies that the performance-tuning material is resistant to absorption of oils. In rejecting claim 26, the Office action asserts that the silicone resin disclosed in Ikegami is inherently resistant to absorption of oils. However, there is no basis to conclude that resistance to oil absorption by Ikegami's silicone resin is inherent. See MPEP § 2112, subsection IV. Accordingly, claim 26 is patentable for the additional reason that the prior art fails to disclose or suggest making a resonator as set forth in claim 24, wherein the performance-tuning material is resistant to absorption of oils.

Conclusion

Applicants respectfully request allowance of the application in view of the foregoing. The Commissioner is hereby authorized to charge $1,020 for a three-month extension of time to Deposit Account No. 50-0496. The Commissioner is also hereby authorized to charge any other required fees or credit any overpayments in this matter to Deposit Account No. 50-0496.

Respectfully submitted,



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Diamond-like carbon

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Diamond-like carbon (DLC) (also known as tetrahedral amorphous carbon, or *ta-C*) is a term which covers a class of amorphous carbon materials containing a significant amount of sp^3 hybridized carbon atoms. DLC can be synthesized as thin films using ion beam deposition or sputter deposition. Depending on the sp^3 to sp^2 hybridization ratio (>60%) DLC films can appear transparent, possess high hardness, and be electrically insulating. DLC is also used in the cylinders of most modern supersport motorcycles.

DLC is an industrially important material, which is used as a coating on hard-disk platters and hard-disk read heads to protect against head crashes.

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